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ABSTRACT

This booklet of experiments was compiled from various teachers' guides in response to the many requests from students for help in preparing smoking demonstrations and exhibits. The booklet is divided into three sections. Part 1 illustrates a number of experiments, most of which require some laboratory equipment. Part 2 includes a number of demonstrations which can be performed by one or two persons. Part 3 contains suggestions for exhibits. Teachers and students will find this a helpful resource for demonstrating the effects of smoking. (JL)

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SMOKING and HEALTH EXPERIMENTS, DEMONSTRATIONS, and EXHIBITS

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Center for Disease Control

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SMOKING and HEALTH EXPERIMENTS, DEMONSTRATIONS, and EXHIBITS

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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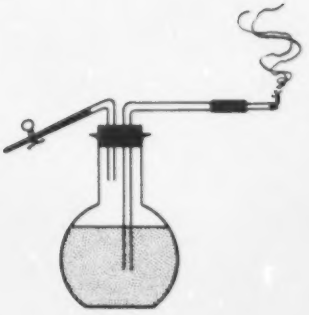
WHERE TO GO FOR INFORMATION ON SMOKING AND HEALTH

Your school or local public library may have the series of reports on the health consequences of smoking beginning with the report entitled "Report of the Advisory Committee to the Surgeon General of the Public Health Service" published in 1964. Subsequent reports were published in 1967, 1968, 1969, 1971, 1972, 1973, 1974, and 1975. The most recent of these reports are also available from the Government Printing Office, Washington, D.C. 20402.

The following agencies have material on smoking:

Local Interagency Council on Smoking and Health
Local Health Department
Local branch of American Cancer Society
Local branch of American Heart Association
Local branch of National Tuberculosis Association



INTRODUCTION

Ever since the Surgeon General's Report on Smoking and Health was released to the public January 11, 1964, schools throughout the country have stepped up their health education programs in this area. Youngsters, as well as parents and teachers, have shown an increasing interest in the smoking problem and in many instances have developed their own anti-smoking programs and activities.

In response to the many requests from students for help in preparing smoking demonstrations and exhibits the following material has been compiled from various teachers' guides. It is divided into three sections. Part I illustrates a number of experiments, most of which require some kind of laboratory equipment. Students should, of course, consult with their science teacher or advisor before attempting the more complicated demonstrations.

Part II includes a number of demonstrations which can be performed by one or two persons. Part III contains suggestions for exhibits.

PART I: EXPERIMENTS

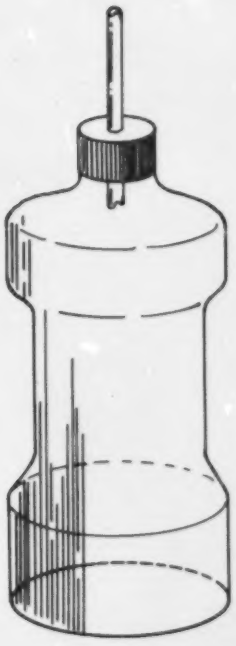
A. SMOKING MACHINES

Various types of smoking machines can be devised which are effective in demonstrating a number of important points about cigarette smoking. The amount of tar in one or more cigarettes can be shown by collecting tar on cotton pellets or filter paper placed in the tubing of the machine. Tar can also be observed as a residue on the tubing and containers and as a discoloration of water through which cigarette smoke has been filtered. This discolored water can be compared with fresh, clear water and it can be smelled and tasted to demonstrate what goes into the human lungs when a person smokes.

The varying amounts of tar in different brands and types of cigarettes can be compared by "smoking" filtered and unfiltered cigarettes and collecting the residue. To make a fair test, be sure to smoke each cigarette to the same length as measured from the unfiltered end.

By using an empty flask instead of one filled with water to collect smoke, it is possible to demonstrate how long the smoke remains in the lungs and how offensive an odor it creates. Collections can also be used to demonstrate effects on living things as described in Part B.

EXPERIMENT #1-A



Equipment:

plastic soap container, or other empty plastic container, transparent if possible.

ball point pen barrel or other tubing approximately size of a cigarette.

cotton

cigarettes

Procedure:

Rinse the container thoroughly.

Make an opening in the cap of the container to fit the tubing into the cap.

Place the tubing in the opening and seal tight with cement or clay if needed.

Insert loosely packed cotton ball into tubing.

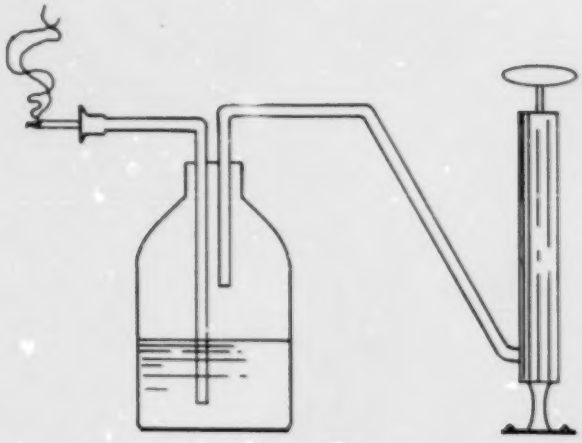
Insert cigarette into open end of tubing.

Press firmly on the plastic container to force air out before lighting the cigarette, then proceed with slow and regular pumping action.

Withdraw cotton from tubing to show accumulation of tar.

Pass container around for individuals to smell and to observe that smoke continues to be expelled for a period of time.[a]

EXPERIMENT #2-A



Equipment:

Large gallon jar with a two-hole stopper

Cigarettes

Delivery tubes (glass)

Cigarette holder

Vacuum pump

Procedure:

Assemble cigarette tar separating apparatus as shown in diagram.

Fill the gallon jar half full with water.

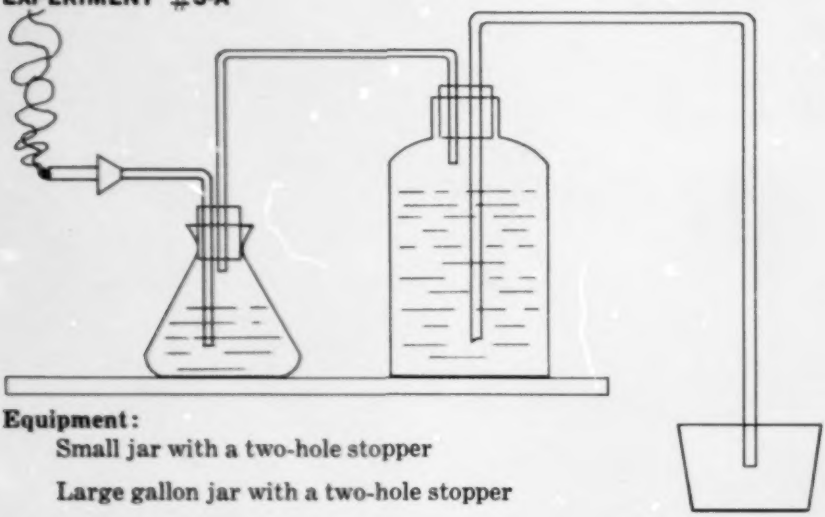
Place cigarette in intake and light.

Pump vacuum pump so as to draw smoke from cigarette into gallon jar and water.

Pump until cigarette is burned completely. Replace with additional cigarettes until tars can be seen in water.

Examine color of water, smell, and taste the liquid.[3]

EXPERIMENT #3-A



Equipment:

Small jar with a two-hole stopper

Large gallon jar with a two-hole stopper

Bucket or pan

Several cigarettes

Delivery tubes (glass)

Cigarette holder

Procedure:

Assemble the cigarette tar separating apparatus as shown in the diagram.

Fill the small jar half-full of water.

Fill the large jar to the top with water.

Place a cigarette in the intake and light it.

Start the flow of water from the large jar into the bucket by sucking the water in the outlet tube to start the water siphoning out of the large jar. This will create a suction in the jars and cause the cigarette to burn. The tars will collect in the water in the small jar.

Allow the cigarette to burn completely. Add more water to the large jar if necessary to maintain suction.[9] *

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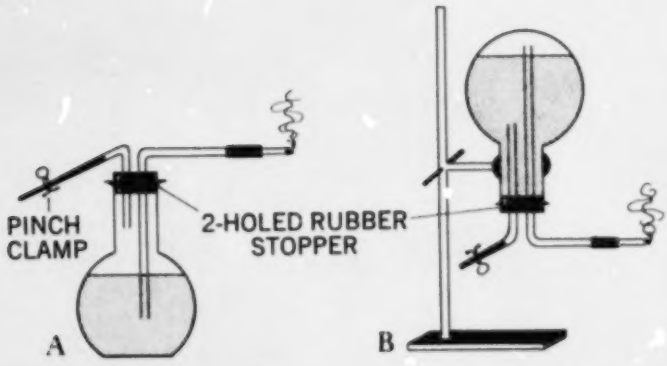
EXPERIMENT #4-A



Equipment:

Flask

Two-holed stopper

Glass tubing

Rubber tubing

Pinch clamp

Cigarette

Stand

Procedure:

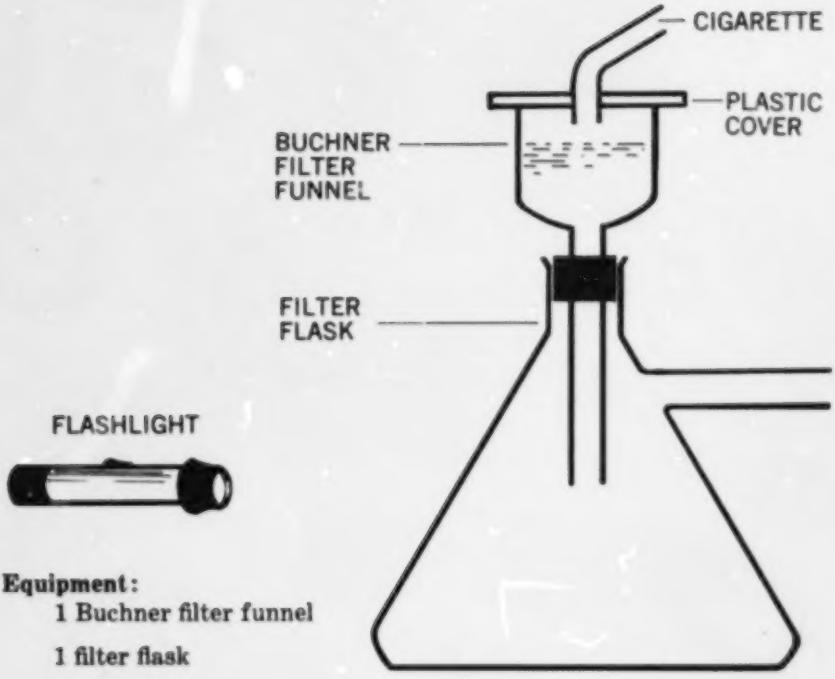
Fill flask approximately three-fourths full of water. Close the flask with a two-holed stopper fitted with glass tubes. Invert the flask holding finger over end of tube until inversion is complete.

Fit a cigarette into one end of a piece of rubber tubing and connect the other end to glass tube as shown.

Start the siphon and light the cigarette. The pinch clamp may be used to open or close the siphon at regular intervals to stimulate puffing on the cigarette.

Observe the dense smoke which collects above the surface of the water. Shake the inverted flask to wash the smoke with the water. Note the color that appears. Empty the flask and note the residue on the inside walls of the flask.[3]

EXPERIMENT #5-A



Equipment:

1 Buchner filter funnel

1 filter flask

Glass tubing

Plastic cover

Filter paper

Flashlight

Cigarette

Procedure:

Set up filter apparatus as shown.

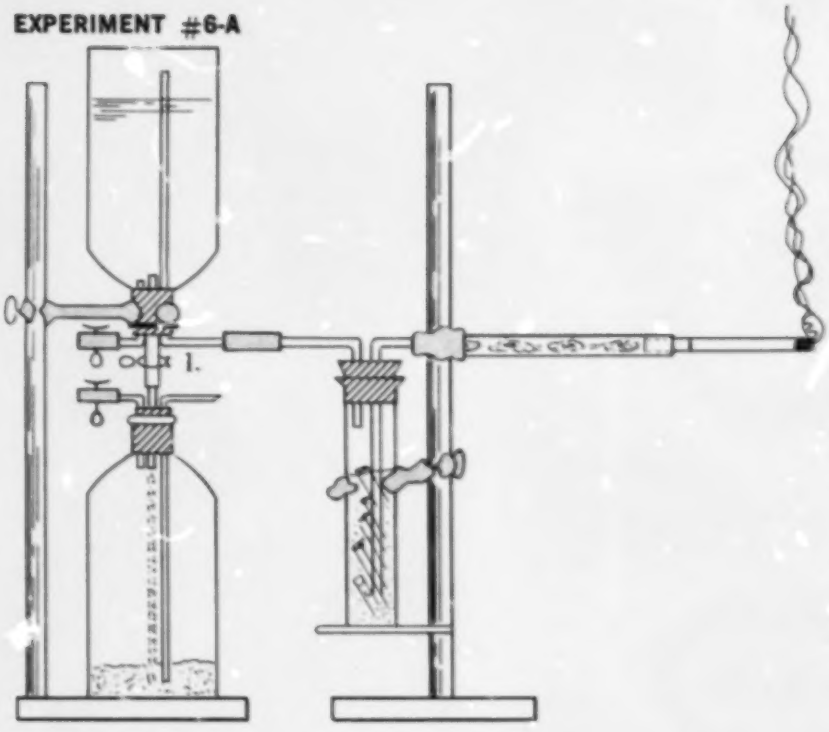
Moisten filter paper and place in funnel.

Grease may be used to seal the lid or cover on the funnel. Glass tubing is slipped through small hole in plastic cover.

Start cigarette smoking with vacuum source.

Note tar residue on filter paper. Observe the smoke particles which pass through the filter paper by directing flashlight on the contents of the filter flask.[3]

EXPERIMENT #6-A



Equipment:

Ringstand and clamp

Pinch clamps

Two one-gallon jars

Long, narrow flask or bottle

Two-holed rubber stoppers to fit jars and flask

Six feet of glass tubing

Four to five feet of clear plastic tubing

Rubber tubing

Cigarettes

Cotton pellets

Procedure:

Place the cotton pellets in a piece of glass tubing so they are not touching each other. Set up equipment as shown.

Suction is created by the gravity flow of water from the full jar to the empty one. When all of the water has escaped from the upper jar, it is replaced by the one which is now full.

Place a cigarette in the rubber tube at end of line issuing from the small flask.

Remove pinch clamps (1) and (2) and light the cigarette. The pinch clamp (1) should be released and tightened periodically to simulate a smoker drawing on a cigarette. The smoke will bubble through the water in the small flask.

As the cigarettes are smoked, tar will collect on the cotton pellets. An empty flask can be substituted for the small water-filled flask to collect smoke.

Substitute about 3-4 feet of clear plastic tubing for collection jars to demonstrate the accumulation of tar deposit on the air passages of the human smoker.[1]

• • •

B. EXPERIMENTS TO SHOW EFFECTS OF SMOKE ON LIVING THINGS

There are at least 500 chemicals or compounds in the cigarette smoke. Not all have been identified, but some have been proved capable of producing cancer and others are poisonous if taken in concentrated doses. The known chemical agents in smoke include lead, arsenic, cyanide, nicotine, formaldehyde, and carbon monoxide. The following experiments will show the effects of these elements of cigarette smoke on living things. No experiment on living animals should be undertaken unless a qualified adult supervisor assumes direct responsibility for the purposes and conditions of the experiment. The comfort of the animal used in any study should be of prime concern to the student investigator.

Simple Experiments:

1. Using a cotton pellet which has been saturated with tars from the smoking machine, wipe the stems of several growing plants. Keep some plants as controls to observe the differences.[1]

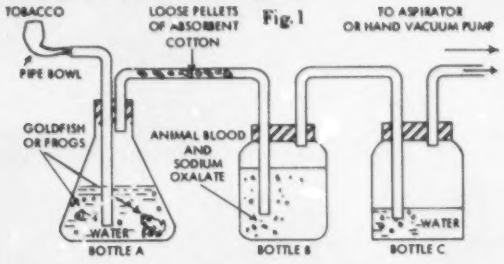
2. Wipe a cotton pellet which has been saturated with tobacco tars on the tongue of a live frog and note temporary collapse.[1,2]

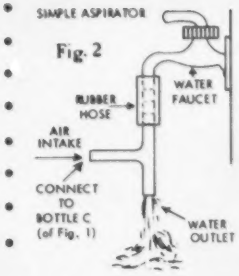
3. Place a small fish in water flask of smoking machine and note how the nicotine poisoning causes the fish to roll to one side. As soon as this happens, place fish in freshly aerated water to revive. Substitute tadpoles for fish and observe the results. (See illustration on next page.)[1,2,3,4,5]

4. Place a drop of solution containing paramecia on a microscope slide. With the low power of a microscope, observe the movement of these one-celled organisms. Below smoke from collection flask on the preparation and note the effects on the paramecia.

5. Make a nicotine insecticide by soaking cotton pellets from smoking machine or cigarette tobacco in water. Test and use as spray on insects.

ADVANCED EXPERIMENT #1-B





Advanced Experiments:

Purpose:

This experiment is to test the effects of carbon monoxide in tobacco smoke on animal blood. (The blood can be obtained in a butcher shop. Keep the blood from coagulating by adding one part of sodium oxalate solution to 9 parts of blood. Place in bottle.)

Equipment:

Smoking machine, as shown

Cotton pellets

Animal blood

Cigarettes or tobacco and pipe

Sodium oxalate solution

Gold fish or frogs

Yeast

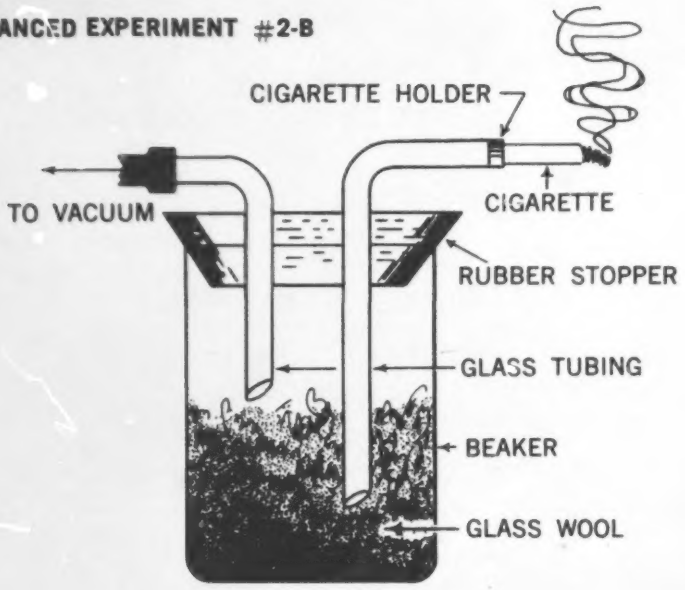
Procedure:

Smoke a cigarette or tobacco in manner described for machines in Section A. Smoke coming through the tube from bottle A to bottle B will cause the blood to turn a deeper red as the hemoglobin takes on carbon monoxide. As a result carboxy-hemoglobin is formed. This is what happens in carbon monoxide poisoning. The hemoglobin loses its ability to release oxygen.

Add a fresh yeast culture to the blood. Also add a yeast culture to a control batch of blood. In the control, yeast enzymes cause the hemoglobin to release oxygen which comes off as bubbles in a foam at the surface. In the experimental bottle, this oxygen release is impaired.

(Bottle C is simply a trap, to keep blood from frothing into the pump or aspirator.)[2]

ADVANCED EXPERIMENT #2-B



Purpose:

To observe the biological effects of cigarette tars on white mice.

Equipment:

6-10 white mice

Aspirator or water pump

Flask, beaker, or bottle

Acetone

Electric Clippers

Eye dropper

Rubber tubing

Stopper with glass tubing holes

Glass tubing

Glass wool

Cigarettes

Procedure:

Hook a vacuum line (from an aspirator or water pump) to a burning cigarette in such a manner that the cigarette is consumed

in about 4-6 minutes. In the line a trap containing glass wool moistened with acetone should be attached. This will collect most of the tobacco tars. The distillation of the tar can be facilitated by placing the bottle in an ice water bath during the course of the experiment.

After the cigarettes (about 40 per day) have been smoked, the tar can be removed with additional acetone—using as little as possible to dissolve the tar. This solution should be allowed to stand for several hours in a fume hood to concentrate the tar. A vacuum distillation method in a warm water bath without flame is effective.

The backs of mice should be trimmed with electric clippers to remove heavy hair growth. The tars from about three cigarettes can be applied by eye dropper twice daily to the clipped area, five days a week.

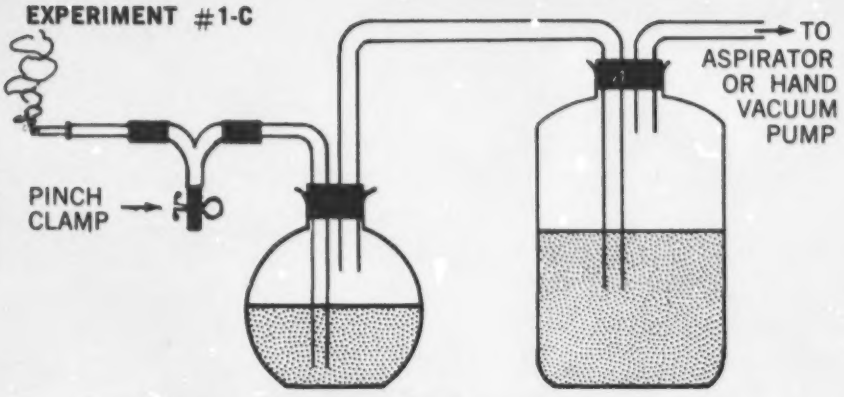
Tumors can be expected to appear in about 40 percent of the mice in 6 to 9 months. These will be both benign and malignant tumors.[4]

#3B Effect of smoke on respiratory tract.

Put a salamander to sleep by soaking him in a solution of saturated chloretone diluted by adding nine parts of water, or in one percent aqueous solution of Tricaine Methanesulphonate. As soon as it is asleep, cut off the head, open the chest and abdominal cavity, slit the lung longitudinaily and snip it off. Keep the speciment wet with Ringer's solution. Examine the lung surface under the microscope to study the cilia beating. Blow a little smoke from collection flask over the tissue and observe the effect it has on the cilia.[1]

#4B Effect of smoke on circulatory system.

Pith a frog and place on its back on a frog board. Spread and pin the web of a foot over an opening in the board and examine the blood vessels under a microscope, low power. Keep the specimen moist with Ringer's solution. Place a tube from the smoke bottle in the frog's mouth and blow smoke in while someone is watching the rate of blood flow. If it is possible to count the blood cells going past a given point, you may notice several rate changes; faster, then back to normal and maybe faster again and back to normal a second time.[1]



C. EXPERIMENTS TO SHOW EFFECT OF SMOKING ON THE LUNGS

Equipment:

Flask

Large jar

Two-holed stoppers

Glass tubing

Rubber tubing

Y-tube

Pinch clamp

Cotton pellets or strands of glass wool

Cigarettes

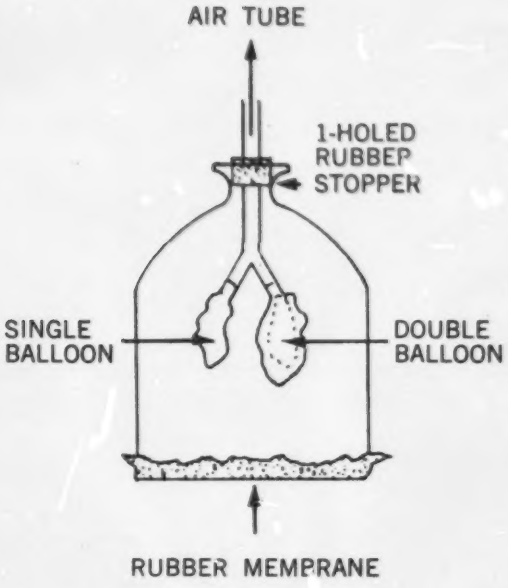
Procedure:

This is a smoking machine similar to those described in part A with the exception that a Y-tube is used to collect the tar deposits.

Insert small pellets of cotton or strands of glass wool in the straight section of glass tubing between cigarette and Y-tube. Also place loose pellets of cotton or glass wool at all points of Y.

Observe if more tar precipitates at the Y-shaped bifurcation. Compare the Y-shaped bifurcation with the structure of the bronchial tree in the lungs of humans. (Note: There is a more frequent occurrence of lesions at the bifurcations than elsewhere in the bronchial epithelium of heavy cigarette smokers.)[3,5]

EXPERIMENT #2-C



Equipment:

Bell jar

Forked glass tubing

One-holed rubber stopper

Rubber sheet or membrane

Balloons similar in size and elasticity

Procedure:

Blow up one balloon and allow it to remain inflated for a day or two. When ready for demonstration deflate the balloon and note that it remains enlarged and stretched.

Insert an unused balloon into the used one and note the space or air pocket surrounding the new balloon.

Attach a new single balloon to one of the ends of the forked glass tube and the double balloon to the end of the other tube. Fasten a rubber sheet or membrane across the bottom of the bell jar to simulate the diaphragm.

Pull down on the center of the rubber membrane and observe the balloons fill with air. Note the effect of the double balloon on amount of expansion which takes place. Push the rubber membrane back up into the jar a short way to simulate exhaling. Note the difference in the deflation of the "lungs."

The action of filling and emptying the balloons may be compared to respiration; if both lungs are functioning properly they inflate and deflate properly. But if the alveoli of the lungs have been stretched too thin, as in emphysema, air pockets form in the lung tissue. The contractile power of the lungs is destroyed.[3,8]

PART II: DEMONSTRATIONS

The following demonstrations can be performed by one or two persons and require no laboratory equipment. They are useful in illustrating some of the facts that are known about the effect of cigarette smoking on the body.

A. To demonstrate the tars that are inhaled into the mouth and lungs of a cigarette smoker. Of particular interest will be the difference in the amounts of tar in the inhaled smoke and in that which is exhaled.

Equipment:

1 white handkerchief

1 smoker

Procedure:

Have the smoker inhale from a lighted cigarette, making every attempt to hold the smoke in his mouth without allowing it to go into the lungs. As rapidly as possible, after inhaling from the cigarette, place a handkerchief over the mouth stretched as firmly as possible and blow the smoke back through the handkerchief. You will note that this will cause quite a dark stain.

Now have the smoker inhale once more from the cigarette only this time allowing the smoke to go well into the lungs. Now again, place a different area of the handkerchief firmly over the mouth and exhale back through the handkerchief. It will be noted that the second stain is much lighter than the first stain. Theoretically, the difference between the two stains represents th amount of tar that remains in the lungs with each puff of the cigarette.[4,7,8,5]

DEMONSTRATION #1

B. To demonstrate the effect of smoking on the heart and circulatory system.

Equipment:

Wrist watch

Smoker

Cigarettes

Procedure:

It is recommended that students do this experiment on their parents at home and record their findings. The arterial pulse,

taken at the wrist, is an accurate indication of the heart rate. One can take the pulse of his patient by placing two middle fingers of the right hand on the thumb side of the wrist of the patient.

The patient's pulse should be taken two or three times to establish a base line accuracy. In each instance record your pulse rate as the number of pulsations felt per minute.

Have your patient light a cigarette, then take the pulse as he has concluded the 3rd or 4th puff. When the cigarette is finished, take the pulse every fifteen minutes until the pulse rate returns to normal.

Chart your findings on a graph and determine how many extra beats one pack of cigarettes causes the patient. Since with each beat the heart pumps approximately 70cc of blood, calculate the extra volume of blood that is pumped by the heart induced by smoking one package of cigarettes.[4,7,8,8]

#2. The slowing down of blood circulation can be tested with a clinical thermometer. Have the non-smoker, or someone who has not smoked for several hours, hold the thermometer. Then have a smoker hold the thermometer. Smokers show a drop of about 6 degrees or more, even when using filter cigarettes.[8]

#3. Small blood vessels in the toes and fingers are constricted by the action of tobacco. Demonstrate the effect of constriction on the flow of water through rubber tubing. Simply compress the tubing with your hand or squeeze it together with the fingers.[8]

C. To demonstrate what happens to lungs of emphysema patient.

Hold a lighted match approximately 6 inches from open mouth. Without pursing the lips blow out the flame. An individual who cannot do so shows signs of inability to expire air normally which may be an indication of emphysema.[1,8]

D. To demonstrate numbing effect of tobacco on taste buds.

The senses of taste and smell are usually less sensitive in smokers, due to the numbing effect of tobacco on sensory endings in the nose and throat. This effect may be compared with effect of extreme cold. Apply an ice cube to the tongue of a volunteer and determine his ability to taste sweet, sour, bitter and salty substances.[6]

PART III: EXHIBITS

Many students who make smoking machines, such as those described in the first section of this publication, use them as part of a science fair exhibit or project. This, however, presents only one aspect of the smoking problem.

Very effective exhibits can also be developed using the basic facts about smoking and its relationship to death and illness and the economic problems it creates. Such material can be presented as charts or graphs or be carefully lettered on poster board. Various colored papers, gummed letters and numbers can be purchased in art stores to help make the exhibit attractive.

Following are just a few suggestions of the kind of information that might be included in a smoking exhibit. More ideas will come to mind after the subject has been studied and researched.

A. If you have used a smoking machine or performed any of the experiments the results of your work can be shown.

1. Mount the cotton pellets that have been saturated with tar to show how much accumulated with varying numbers and various kinds of cigarettes smoked.

2. Display bottles of water through which smoke has been bubbled and compare with clear water.

3. Mount before and after photographs of experiments with fish or frogs.

4. Exhibit plants that have been treated with nicotine and those allowed to grow normally.

5. Chart data from experiments such as pulse rate before and after smoking, lung capacity test.

6. If a smoking machine is to be part of the exhibit, it might be hooked up to a cutout model of a man with clear plastic tubing representing his respiratory system. As model "smokes", tar accumulation will be demonstrated.

B. Other information which might be presented with or without experimental devices:

1. Graphs or charts showing the rise in death rates from the major diseases associated with smoking.

2. Graphs or charts comparing deaths from smoking-associated diseases with those not associated with smoking.

3. Graphs or charts comparing over-all death rates of smokers and nonsmokers.

4. Illustration of amount of sickness and time lost from work that results from smoking.

5. Locate diseases associated with smoking on outline figure of human body.

6. List other undesirable results of smoking.

7. Compute cost of smoking 1 or 2 packs a day or a week and list what could be bought with the same amount of money.

8. Collect and mount newspaper articles about smoking.

9. List known components of tobacco smoke and pair with poison labels from common household products containing these chemicals.

SOURCES OF SMOKING EXPERIMENTS AND DEMONSTRATIONS

1. *Smoking and Youth.* Developing A Smoking and Health Program Leaders' Manual. June, 1965. State of Washington Department of Health.

2. *Smoking and the Health of Youth.* A resource unit published by the Departme... of Public Instruction and Department of Health, Commonwealth of Pennsylvania, 1963.

3. *Teachers Guide on Smoking and Health.* Grades Five through Eight in Elementary Schools. California Inter-Agency Council on Cigarette Smoking and Health.

4. *Curriculum on Smoking and Health.* Cigarette Cancer Committee of Roswell Park Memorial Institute, New York State Department of Health.

5. *Smoking and Its Relationship to Health and Disease.* A Resource Guide for Michigan Teachers of Grades 5-12. East Lansing, Michigan, Michigan Health Council, 1964.

6. *Smoking and Health.* An Experimental Unit for the Intermediate Grades. The University of the State of New York/The State Education Department Bureaus of Elementary and Secondary Curriculum Development/Albany, New York.

7. *The Health Hazards of Smoking.* Cleveland Public Schools, Cleveland, Ohio.

8. *Smoking and Health Guide for Elementary and Secondary Schools.* State of Washington Department of Public Instruction, 1967.

9. *Biology Investigations.* By James Otto and Sam Blane, Holt, Rinehart and Winston, Inc. 1956.